

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

6. V. - M. N.
~~589-29~~
Issued October 7, 1907.

United States Department of Agriculture,

FOREST SERVICE.

GIFFORD PINCHOT, Forester.

SILVICAL LEAFLET 3.

ENGELMANN SPRUCE.

Picea engelmanni Engelm.

Engelmann spruce is a small, knotty tree, which grows at high altitudes and furnishes an inferior grade of lumber. In the absence of better species, however, it is in demand in many parts of the Rocky Mountains for lumber, mine timbers, poles, and boxes, and is extensively cut. It is also cut to some extent for pulpwood, and its use in paper making will doubtless increase in the future. The dense forests of which it forms a part are of high value as a protection to watersheds.

RANGE AND OCCURRENCE.

The range of Engelmann spruce extends southward from southern British Columbia over the Rocky Mountains to southern New Mexico and Arizona, and westward through Montana and Idaho to the mountains of Washington and Oregon. The tree grows at high altitudes—a result of its demands on soil moisture. Its lower altitudinal limits are in moist canyons or on protected northerly slopes. In favorable situations it grows to merchantable size, but at timber line it is either stunted or deformed.

The lower temperatures and less intense light in the northern part of the range of Engelmann spruce result in favorable moisture conditions at lower altitudes than in the south. A gradual lowering of its altitudinal range in higher latitudes takes place in consequence. This variation is not consistent throughout the tree's range, but is influenced by local climate. In general its altitudinal range in Arizona and New Mexico is from 8,500 to 12,000 feet; in Colorado and

Utah, from 6,000 to 12,000 feet; in Idaho, Wyoming, and Montana, from 2,000 to 11,000 feet; in Oregon, from 2,400 to 8,000 feet; in Washington, from 1,000 to 7,000 feet; and in southern British Columbia, from 2,500 to 6,000 feet.

CLIMATE.

The wide range of Engelmann spruce subjects it to varied climate. It receives an average annual precipitation of over 25 inches, largely in the form of snow. It experiences a wide seasonal range of temperature, with a minimum in the north of approximately -40° F. and a southern maximum of about 95° F. The daily range of temperature is great in its upper altitudinal range; it is less at lower altitudes and on northerly aspects.

Differences in the length of the growing season are accompanied by corresponding variations in the tree's rate of growth. Near timber line, where the growing season is usually not more than two months long and freezing temperatures occur almost nightly, very slow growth is made, while in its lower range, where the growing season lasts about four months and frosts are less frequent, it grows more rapidly both in height and diameter.

HABIT.

In situations to which it is adapted, Engelmann spruce is a tall, symmetrical tree, resembling the eastern white spruce in appearance. Its crown is narrow, compact, and spire-shaped, and, except in the closest stands, reaches almost to the ground. Under less favorable conditions the tree is shorter and the crown conical in shape. The leaves, if not overshadowed, are retained for many years. The root system is horizontal, somewhat deeper than that of lodgepole pine, but still quite shallow and seldom reaches a depth of more than 2 feet. The bole has a rapid taper, is straight and usually sound. The bark is thin, and the tree is susceptible to damage from fire.

The average size of mature Engelmann spruce in good situations varies from 80 to 90 feet in height and from 24 to 30 inches in diameter throughout the central and southern parts of its range to 140 feet in height and 3 feet in diameter in northern Idaho and Washington. In the North it occasionally attains a height of over 160 feet and a diameter of 5 feet.

It is a tree of slow but persistent growth. In the region of its greatest commercial importance it becomes merchantable at a diameter of about 12 inches, which it attains at an age of from 125 to 150 years. Its most rapid growth in height occurs between the twentieth and fortieth years. Its diameter growth is most rapid at about the fiftieth year. It lives to be from 200 to 300 years old.

ASSOCIATED SPECIES.

Engelmann spruce forms large pure stands, and grows also in mixture with other species. Pure stands are more frequent in the South than in the North. Its most common associates are alpine fir, which closely resembles it in silvical characteristics as well as in geographical and altitudinal range, and Douglas fir, with which it grows sparingly in lower altitudes. It grows at high elevations in Arizona and New Mexico with Alpine fir and limber and bristlecone pines, and at lower altitudes with white and Douglas firs and aspen. In Arizona it also associates with Arizona fir. In Colorado, Utah, Wyoming, southern Montana, and southern Idaho its chief associate is alpine fir, but it also grows with white bark, lodgepole, and limber pines, blue spruce, Douglas fir, and aspen. In Colorado and Utah it also occurs in mixture with bristlecone pine and with white fir. In northern Montana and northern Idaho it associates with alpine fir, alpine larch, white-bark, lodgepole, and western white pines, and Douglas fir, and sparingly in its lower range with lowland fir, western larch, western hemlock, and giant arbovitæ. It grows in the Blue Mountains of Washington and Oregon with western larch, lodgepole pine, and white, lowland, and Douglas firs. In northern Washington it sometimes forms pure stands, but is usually in mixture with alpine fir, alpine larch, black hemlock, yellow cedar, and white-bark pine. In the Cascade Mountains of Oregon it is associated with alpine, noble, white, and Douglas firs, black hemlock, and lodgepole pine.

SOIL AND MOISTURE.

Engelmann spruce will grow on most soils, provided they furnish it sufficient moisture. It will grow in fairly dry situations, but usually gives way on porous soils to lodgepole pine, Douglas fir, and other species requiring better drainage. With alpine fir it does well on a retentive soil like fine loam, and attains its best development on deep, rich soils of gulches and river valleys. Its shallow wide-spreading root system enables it to grow on thin soils of moderate slopes and in wet situations on the margins of rivers, lakes, and swamps.

TOLERANCE.

Engelmann spruce is very tolerant of shade, and exceeds alpine fir and most of its other associates in this respect. It will endure shade for years, and will recover and make good growth when released from suppression. On account of its tolerance it usually forms close stands, in which all ages are represented, and preserves good forest conditions. In the Bighorn Mountains of Wyoming the stand con-

sists usually of even-aged, dominant trees, with a sprinkling of intermediate spruce and lodgepole pine and a sparse understory of alpine fir. It is somewhat more tolerant in youth than in old age. In pure stands or with alpine fir it preserves its identity as a permanent type by reproducing abundantly under its own shade. With other tolerant species it tends to succeed temporary types of intolerant species—notably lodgepole pine—where these occur in situations favorable to it. Its tolerance is exhibited by its branchy habit, which it retains to a considerable extent even in dense stands.

REPRODUCTION.

Seed production begins at about the twenty-fifth year and continues up to an advanced age. Over most of its range seed is borne in abundance; especially heavy seed years occur in some localities at three-year intervals. The seeds germinate best in a mineral soil, and seedlings rarely grow in accumulation of humus. An abundant supply of soil moisture is essential to germination. The seeds are winged and may be carried by the wind.

Notwithstanding its prolific seed production, seedlings of Engelmann spruce are not usually very abundant. They are most numerous in small protected openings in the forest. The low branches of isolated seed trees afford favorable conditions for germination and protection of the seedlings, and groups of trees are thus gradually built up, which, as they increase in size, coalesce to form larger stands.

MANAGEMENT.

Because of its great tolerance and demand upon soil moisture the Engelmann spruce is best managed under the selection system. Heavy cuttings are likely to destroy the forest conditions and dry the soil, which is fatal to the superficial roots of the remaining trees and to germination of the seeds. Clear cutting in the form of very narrow strips may be successful, but since stands of Engelmann spruce usually contain trees of all sizes, this would entail a great sacrifice of immature trees, unless there is a ready market for small-sized material.

[Leaf. 3]